ACCESSION #: 9612260057

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Calvert Cliffs, Unit 2 PAGE: 1 OF 08

DOCKET NUMBER: 05000318

TITLE: Automatic Reactor Trip Trip Due to Closure of Feedwater

Regulating Valve

EVENT DATE: 11/17/96 LER #: 96-005-00 REPORT DATE: 12/17/96

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: R. C. Gradle, Associate Engineer TELEPHONE: (410) 495-3738

COMPONENT FAILURE DESCRIPTION:

CAUSE: X SYSTEM: SJ COMPONENT: FCV MANUFACTURER: F130

REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On November 17, 1996, at 1059 a.m., Calvert Cliffs Unit 2 automatically tripped on low water level in No. 21 Steam Generator when No. 21 Feedwater Regulating Valve (FRV) went shut. The plant was brought to a safe shutdown condition. This event resulted in no significant consequences to public health and safety. At the time of the event, Unit 2 was at 100 percent power.

The cause of the event was failure of the spring retainer in No. 21 FRV positioner. The spring retainers for Nos. 21 and 22 FRV positioners were replaced. We will inspect the similar Unit 1 FRV positioner spring retainers at the next shutdown of sufficient duration.

Other corrective actions include an evaluation of applicable maintenance procedures and training on this event to appropriate site personnel.

I. DESCRIPTION OF EVENT

At 1059 hours on November 17, 1996, Calvert Cliffs Unit 2 Reactor Protective System (RPS) automatically tripped the reactor on a low water level (-50 inches) condition in No. 21 Steam Generator. The low level in No. 21 Steam Generator resulted when No. 21 feedwater regulating valve (FRV) went shut. The plant was brought to a safe shutdown condition. At the time of the event, Unit 2 was in MODE 1 (Power Operation) at 100 percent power. There were no other structures, components, or systems that contributed to this event because they were inoperable at the start of the event.

Immediately prior to the event, licensed Plant Operators received and acknowledged three feedwater system control trouble alarms that annunciated in the Control Room. These feedwater system alarms were followed a few seconds later by a steam generator low level pre-trip (-29 inches) Control Room alarm. Approximately nine seconds after receipt of the first feedwater system alarms in the Control Room, the Unit 2 reactor automatically tripped at 1059:09 due to low water level in No. 21 Steam Generator.

Emergency Operating Procedure (EOP)-0, "Post-Trip Immediate Actions," was implemented when the unit tripped. All safety functions were met. No. 22 steam generator feed pump (SGFP) tripped at 1059:13 on high discharge

pressure. At 1059:44, auxiliary feedwater (AFW) system flow was initiated with the automatic starting of No. 21 and No. 23 AFW pumps. Number 21 SGFP was noted by Control Room personnel to be idling at a low speed. In accordance with EOP-0, operators manually tripped No. 21 SGFP and used the AFW system to restore steam generator levels. At approximately 1108, Control Room operators noted that No. 22 SGFP appeared to reset and would not manually trip. Operations personnel secured No. 22 SGFP by isolating steam supply to the SGFP turbine. Emergency Operating Procedure-O was completed satisfactory at 1114 and EOP-1, "Reactor Trip," was implemented. All EOP-1 final safety function status checks were completed satisfactorily at 1205 and the plant entered Operating Procedure (OP)-4, "Plant Shutdown From Power Operation To Hot Standby."

Each steam generator is equipped with three-element control in order to produce a demand signal for feedwater flow which is a function of the difference between the feedwater and steam flows, trimmed by the steam generator downcomer level error. The FRV position demand signal for each steam generator is sent to the corresponding FRV controller that in combination with the turbine driver speed control system, controls the level in each steam generator by modulating the feedwater flow. The regulating valve controller with input from the digital feedwater control system automatically adjusts the position of the regulating valves. Upon a main

turbine trip, the FRVs are automatically closed and the feedwater bypass valves are automatically opened to provide the required decay heat removal flow. The AFW system is designed to provide feedwater to the steam generators for the removal of sensible and decay heat, and to cool the primary system to 300 degrees Fahrenheit in case the main feedwater pumps are inoperative.

II. CAUSE OF EVENT

The cause of the reactor trip was a valid RPS signal generated as a result of low water level (-50 inches) in No. 21 Steam Generator. This signal resulted when No. 21 Steam Generator FRV unexpectedly closed. Investigation of No. 21 FRV discovered a broken bolt (spring retainer) in the valve positioner mounted on top of the valve actuator. The spring retainer is approximately 2 inches long and 1/4 inch in diameter. The actuator stem position feedback is provided to the valve positioner through movement of the range spring attached by the spring retainer to an extension of the actuator piston rod (see Figure 1). This feedback arrangement is designed to prevent over-correction and insure a definite position of the actuator piston rod for a given input signal to give a stable and accurate response to a change in controlled conditions. When the spring retainer gave way, the range spring released causing the valve positioner for No. 21 Steam Generator FRV to sense that the valve was full open. The valve positioner responded by sending a closing signal to

No. 21 Steam Generator FRV actuator and the valve shut.

Following the event, the Plant General Manager established a Significant Incident Finding Team (SIFT) to determine the cause(s) of the event, initiate corrective action, and formulate recommendations to prevent recurrence. Results of the ongoing investigation indicate that the immediate cause of this event was the failure of No. 21 FRV positioner spring retainer due to torsional overload, equivalent to overtorquing the spring retainer. The SIFT identified other plausible causes for No. 21 FRV closure, then refuted each one on a case by case basis. The spring retainer is manufactured from low carbon steel. The failure mode of the spring retainer was determined from a metallurgical failure analysis on the broken retainer. This failure analysis also determined that the failure was not recent and was probably many months old. The failure analysis could not determine whether the fracture was complete or if a small amount of the retainer remained intact, most probably at the thread, which then failed later. The failure analysis stated that approximately one thread remained intact above the fracture surface and this may have been sufficient to keep the retainer and the actuator extension piece together during the previous Unit 2 operation.

The SIFT conducted an extensive document review (including maintenance orders, technical references, drawings and various procedures) and personnel

interviews. The spring retainer for No. 21 FRV positioner was installed during performance of approved maintenance during the spring 1995 Unit 2 refueling outage. During this maintenance, the plant technicians encountered difficulty with the calibration of No. 21 FRV positioner. This caused several removal/installation sequences for the spring retainer. The SIFT believes that the spring retainer for No. 21 FRV positioner broke (fractured) during its final installation, however, the spring retainer remained held in place by the one remaining thread engagement. There is no torque specification given in the technical manual (Fisher Controls 3570 Series Pneumatic Positioners Form 1837, dated November 1989) for the installation of the spring retainer. At Calvert Cliffs the Fisher Controls Model 3750 valve positioner is only used on FRVs.

Similar difficulties were encountered at the same time (1995 Unit 2 refueling outage) by plant technicians during the calibration of No. 22 FRV positioner, however, the spring retainer for this positioner was subsequently found to be in satisfactory condition. Following successful completion of the calibration/calibration check procedure of No. 21 and No. 22 FRV valve positioners discussed above, Nos. 21 and 22 FRVS were successfully time response tested.

Following the event, five new replacement spring retainers were obtained from the vendor. Each retainer underwent a magnetic particle examination. No indications were found. Plant technicians replaced the

spring retainer in Nos. 21 and 22 FRV positioners using an approved maintenance order. Post-maintenance calibration of the these FRV positioners and FRV stroke time-response testing were completed satisfactory. The removed spring retainers were saved for analysis.

III. ANALYSIS OF EVENT

This event is considered reportable in accordance with 10 CFR 50.73(a)(2)(iv), "Any event or condition that resulted in a manual or automatic actuation of any engineered safety feature (ESF), including the reactor protection system (RPS)."

This event resulted in no significant consequences to the public health and safety. The RPS automatically tripped the reactor on low water level in No. 21 Steam Generator. Following the unit trip, AFW flow was automatically initiated to the steam generators. All safety systems functioned as designed.

The Calvert Cliffs Updated Final Safety Analysis Report, Chapter 14, Safety Analysis defines a loss of feedwater (LOFW) flow event as a reduction in feedwater flow to the steam generators without a corresponding reduction in

steam flow from the steam generators. The LOFW flow event is a heatup transient. The Safety Analysis describes the most limiting LOFW flow event to occur at 102 percent power due to a failure in the feedwater regulating system which instantaneously shuts both FRVs. The

instantaneous closure of both valves results in a complete cessation of feedwater flow to both steam generators causing the largest steam and feedwater flow mismatch. This flow mismatch results in the most rapid reduction in steam generator liquid inventory. The Safety Analysis credits the RPS low steam generator water level reactor trip to rapidly decrease core heat flux to decay levels, terminate the Reactor Coolant System temperature and pressure transient, and prevent exceeding identified design limits. The analysis of the LOFW flow event for steam generator depletion criteria demonstrates that the subsequent automatic initiation of AFW flow prevents drying out the steam generators. The AFW system is designed to provide sufficient feedwater flow to remove residual heat generation from the Reactor Coolant System following a reactor trip from full power.

The Updated Final Safety Analysis Report, Chapter 14, Safety Analysis of the LOFW flow event described above bounds the plant condition that resulted from this event (i.e., closure of one FRV at 100 percent power). Therefore, no significant safety consequences resulted from this event.

IV. CORRECTIVE ACTIONS

Short Term

A. The Plant General Manager established a SIFT team to determine the cause(s) of the event, initiate corrective action, and formulate recommendations to prevent recurrence.

B. A magnetic particle examination was conducted on new, replacement

spring retainers. No indications were found.

C. The spring retainer for Nos. 21 and 22 FRV positioners were replaced. Post-maintenance testing for the positioners and valve stroke time-response testing for both FRVs was completed satisfactory.

D. A metallurgical failure analysis was conducted on the broken No. 21 FRV positioner spring retainer. The failure of this spring retainer was determined to be due to torsional overload.

E. Calvert Cliffs issued a Nuclear Network notice describing the event.

F. Identified deficiencies related to this event have been documented on Issue Reports and will be addressed in accordance with our corrective action process.

Long Term

A. Lessons learned training on this event will be provided to the appropriate site personnel.

B. We are evaluating the applicable maintenance procedures involving the FRV and its positioner to ensure spring retainer integrity following future maintenance activities.

C. We will inspect the similar Unit 1 FRV positioner spring retainers at the next Unit 1 shutdown of sufficient duration.

D. As mentioned above, a SIFT was formed to assess this event. Additional long term corrective actions may be generated by the

ongoing investigation. If any corrective actions generated from this investigation are associated with the cause(s) of the event, they will be provided in a supplement to this LER.

V. ADDITIONAL INFORMATION

A. Identification of components and systems described in this report.

IEEE 803 IEEE 805

Component or System EIIS Funct System ID

Feedwater System N/A SJ

Auxiliary Feedwater System N/A BA

Reactor Protective System N/A JC

Feedwater Regulating Valve FCV SJ

Steam Generator Feed Pump P SJ

Auxiliary Feedwater Pump P BA

B. Failed Components Information

Fisher Controls Co., Type 3570 Series pneumatic valve positioner spring retainer.

C. Previous Similar Events

There have been two previous reported events involving failure associated with the FRV positioner, however, they are not similar to the cause of this event. LER 317/88-009 described a failed air line to No. 12 FRV positioner that sheared due to cyclic stress and fatigue induced by vibration and inadequate support of a pressure

switch in the instrument air line. LER 318/89-003 described the

failure to identify the need to perform periodic FRV positioner

pedestal gasket replacement.

TEXT PAGE 8 OF 08

FIGURE 1 "(Not drawn to scale)" omitted.

ATTACHMENT 1 TO 9612260057 PAGE 1 OF 1ATTACHMENT 1 TO 9612260057 PAGE 1 OF 1

PETER E. KATZ Baltimore Gas and Electric Company

Calvert Cliffs Nuclear Power Plant

Plant General Manager 1650 Calvert Cliffs Parkway

Calvert Cliffs Nuclear Power Lusby, Maryland 20657

Plant 410 495-4101

BGE

December 17, 1996

U.S. Nuclear Regulatory Commission

Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant

Unit No. 2; Docket No. 50-318; License No. DPR 69

Licensee Event Report 96-005

Automatic Reactor Trip Due to Closure of Feedwater

Regulating Valve

The attached report is being sent to you as required under 10 CFR 50.73

guidelines. Should you have questions regarding this report, we will be pleased to discuss them with you.

Very truly yours,

PEK/RCG/bjd

Attachment

cc: D. A. Brune, Esquire

J. E. Silberg, Esquire

Director, Project Directorate I-1, NRC

A. W. Dromerick, NRC

H. J. Miller, NRC

Resident Inspector, NRC

R. I. McLean, DNR

J. H. Walter, PSC

*** END OF DOCUMENT ***